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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/805,158

03/19/2004

Yoshi Ono

SLA0830

8642

27518

7590

07/26/2005

DAVID C RIPMA, PATENT COUNSEL
SHARP LABORATORIES OF AMERICA
5750 NW PACIFIC RIM BLVD
CAMAS, WA 98607

EXAMINER

PIZARRO CRESPO, MARCOS D

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 07/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/805,158

Applicant(s)

ONO ET AL.

Examiner

Marcos D. Pizarro-Crespo

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 June 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) 1-15 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 16-26 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☒ Claim(s) 1-26 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>3/19/2004</u> . | 6) <input type="checkbox"/> Other: _____ |

Attorney's Docket Number: SLA0830
Filing Date: 3/19/2004
Claimed Foreign Priority Date: none
Applicant(s): Ono, et al.
Examiner: Marcos D. Pizarro-Crespo

DETAILED ACTION

This Office action responds to the election filed on 6/17/2005.

Election/Restrictions

1. Applicant's election without traverse of claims 16-26 in the reply filed on 6/17/2005 is acknowledged. Claims 1-15 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 16, 17, 22, 25, and 26 are rejected under 35 U.S.C. 102(b) as being anticipated by Halliyal (US 6451641).

4. Regarding claim 16, Halliyal shows all aspects of the instant invention including a method of fabricating a non-volatile memory transistor comprising the steps of:

- ✓ Preparing a semiconductor substrate (see, e.g., fig. 5/step S501)
- ✓ Forming a gate stack on the substrate, the gate stack comprising:
 - A single charge trapping layer overlying the substrate and comprising a high-K dielectric material (see, e.g., fig. 5/step S502)
 - An electrode layer overlying the trapping layer (see, e.g., fig. 5/step S503)
- ✓ Forming drain/source regions **104/106** on opposite sides of the gate stack (see, e.g., fig. 1)

5. Regarding claim 17, Halliyal shows the high-K dielectric material comprising hafnium oxide (see, e.g., col.6/ll.37).

6. Regarding claim 22, Halliyal shows the trapping layer is deposited by an ALD method (see, e.g., col.6/ll.33).

7. Regarding claim 25, Halliyal shows the substrate is an SOI substrate (see, e.g., col.5/ll.66).

8. Regarding claim 26, Halliyal shows the transistor is a multi-bit transistor (see, e.g., col.5/ll.20).

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 18, 19, and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Halliyal in view of Tiwari (US 2004/0108537).

12. Regarding claims 18 and 19, Halliyal shows most aspects of the instant invention (see, e.g., paragraph 4 above), except for a step of treating the trapping layer with either plasma exposure or ion implantation to improve the charge trapping characteristics of the layer. Tiwari, on the other hand, suggests using ion implantation or plasma implantation to incorporate trapping centers into Halliyal's trapping layer (see, e.g., par. 0065).

It would have been obvious at the time of the invention to one of ordinary skill in the art to treat Halliyal's trapping layer using plasma exposure or ion implantation, as suggested by Tiwari, to increase the trapping center density of the layer.

13. Regarding claim 21, Halliyal/Tiwari show most aspects of the instant invention (see, e.g., paragraph 12 above), except for a plasma exposure time of 10-100 seconds. Tiwari, however, treats the trapping layer with plasma to incorporate trapping sites into

the layer (see, e.g., par. 0065). Although Tiwari fails to specify the time of duration of the plasma exposure, performing Tiwari's step would necessarily require a certain amount of time. The specification, on the other hand, fails to provide teachings about the criticality of having a specific plasma exposure time of 10-100 seconds. It has been held that time differences will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such time is critical. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the workable ranges by routine experimentation". *In re Aller*, 220 F.2d 454,456,105 USPQ 233, 235 (CCPA 1955).

Since the applicants have not established the criticality (see next paragraph) of the plasma exposure time claimed, it would have been obvious to one of ordinary skill in the art to use these values in the method of Halliyal/Tiwari.

CRITICALITY

14. The specification contains no disclosure of either the critical nature of the claimed plasma exposure time or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

15. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Halliyal/Tiwari in view of Afanas'ev.

16. Regarding claim 20, Halliyal/Tiwari show most aspects of the instant invention (see, e.g., paragraph 12 above), except for the plasma exposure comprising plasma oxygen, plasma nitrogen, or plasma hydrogen. Tiwari, however, teaches that the plasma exposure includes species that form trapping centers (see, e.g., par. 0065). Afanas'ev teaches that nitrogen increase trapping sites in Halliyal's trapping layer and,

therefore, can be used to diminish the degrading impact of hole trapping (see, e.g., pp.2525/col.2/ll.47-52).

It would have been obvious at the time of the invention to one of ordinary skill in the art to use plasma nitrogen in the plasma exposure step of Halliyal/Tiwari, as suggested by Afanas'ev, to diminish the degrading impact of hole trapping.

17. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Halliyal/Tiwari in view of Chooi (US 6486080) and Agarwal (US 2001/0015453).

18. Regarding claim 23, Halliyal shows most aspects of the instant invention (see, e.g., paragraph 4 above), except for a densification anneal step after deposition of the charge-trapping layer. Chooi (see, e.g., col.6/ll.5-7) and Agarwal (see, e.g., par.0005/ll.5-10), on the other hand, suggest following the deposition of Halliyal's trapping layer with an anneal step to densify the layer by filling oxygen vacancies that develop in the layer during its formation.

It would have been obvious at the time of the invention to one of ordinary skill in the art to follow the deposition of Halliyal's trapping layer with the anneal step suggested by Chooi and Agarwal to cure oxygen vacancies develop in the layer during the deposition step.

19. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Halliyal/Tiwari in view of Liang (US 5372957).

20. Regarding claim 24, Halliyal shows most aspects of the instant invention (see, e.g., paragraph 4 above) except for the formation of the drain and source regions comprising an angle source/drain implantation. Liang (see, e.g., col.5/ll.4-7), on the

other hand, teaches that angle implantation would place the ions further into the gate region of Halliyal's transistor without driving in the dopants. The resultant structure would be more immune to hot carrier degradation.

It would have been obvious at the time of the invention to one of ordinary skill in the art to form Halliyal's source/drain regions using the angle implantation suggested by Liang to protect the transistor against hot carrier degradation.

Conclusion

21. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. Papers should be faxed to Art Unit 2814 via the Art Unit 2814 Fax Center. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is **(571) 273-8300**. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.

22. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Marcos D. Pizarro-Crespo** at **(571) 272-1716** and between the hours of 9:30 AM to 8:00 PM (Eastern Standard Time) Monday through Thursday or by e-mail via Marcos.Pizarro@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on (571) 272-1705.

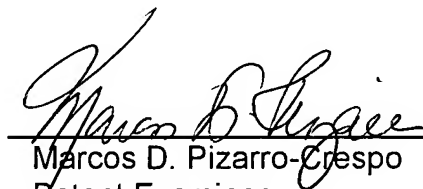
23. Any inquiry of a general nature or relating to the status of this application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or

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Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

24. The following list is the Examiner's field of search for the present Office Action:

Field of Search	Date
U.S. Class / Subclass(es): 257/288,295,310,314,324-326,410,411	7/14/2005
Other Documentation:	
Electronic Database(s): EAST (USPAT, EPO, JPO)	7/14/2005


Marcos D. Pizarro-Crespo
Patent Examiner
Art Unit 2814
571-272-1716
marcos.pizarro@uspto.gov

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